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# THE IMPORTANCE OF ECOLOGY IN THE INTERPRETATION OF FOSSIL FAUNAS[1]

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The interpretation of the extinct faunas that lie buried in the earth's strata has engaged the attention of many students. One who attempts to unravel the mysteries of these buried records must have both imagination and inductive powers. From the remains, often fragmentary, of animals and plants in these strata, the student must build up, bit by bit, a picture of the animal and vegetable life that existed during the period, the kind of an environment in which it flourished, and the general character of the climate. As an example of this kind of interpretation I may mention the underlying rock of Chicago. This limestone is believed to have been deposited in a sea that covered a large part of the middle west. The water was shallow and its temperature relatively high. These facts are indicated by the presence of reef-building corals, which can live only in comparatively shallow water and in a warm climate like Southern Florida.

It is to the interpretation of more recent faunas, however, that I wish to direct your attention at this time, faunas buried during the last great geological period known as the Pleistocene or Glacial Period—the Ice Age. In such interpretation the science of ecology is absolutely indispensable and without such aid grave errors may be made.

Chicago furnishes one of the most striking examples of the value of ecology as an aid in the interpretation of these more recent faunas. In the northern part of the city, and extending northward to Wilmette, there once existed a large embayment of glacial Lake Chicago, the precursor of the present Lake Michigan. In this old lake bed there are many strata superimposed, which contain the remains of life that once lived here. Without a knowledge of the modern or recent ecology of fresh-water life it would be impossible to interpret these strata and rebuild the faunas as they were in life during the several changes that took place in this locality during the retreat of the great ice sheet and the final forming of the great lakes.

Ecology applied to the fossil remains in these strata tells us that this bay was at first a part of the open lake without life, the waters being cold and the environment unfavorable; that there followed a period of low water when the bay was protected from the rough waters of the lake by a bar or reef-shore barrier, and a fauna of swamp or shallow water forms of life occupied the shallow bay. This is indicated by the presence of such snails as *Galba, Planorbis, Physa,* of species that today are found only in swamps or shallow water ponds and lakes. That the climate was cold is attested by the presence of such species of trees along the shore as spruce, tamarack, fir, and arbor vitae, which are now to be found in regions considerably to the north of Chicago.

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[1] Presented before the Ecological Society of America at Chicago on December 20, 1920. Contribution from the Museum of Natural History, University of Illinois, Number 23.

Above this fauna a heavy bed of sand and gravel was laid, indicating a rising water body, and over this stratum, in some places two feet in thickness, there developed a large fauna of river mussels of species that now inhabit our large rivers, indicating that the water was deeper than in the previous stage and that the bay was more open and subject to some wave action. There is a total absence of the fresh-water pulmonates so common in the previous stage. These naiades must have been brought to this habitat by the aid of fish, in the glochidial stage, and liberated from the cysts when the fish reached this bay.

A third stage follows the unionid fauna in which the bay became shallower and the water muddy. There is here a total absence of the river type of naiades and a return to the fresh-water pulmonates of the swamp and shallow pond type. A fourth stage indicates a return to deeper water with a sandy silt bottom inhabited by a few cyclads and gill-bearing gastropods and some fresh-water pulmonates. A fifth stage was probably a land surface, strikingly indicated by the presence of crawfish burrows which are covered by succeeding deposits. A sixth stage indicates a shallow bay inhabited only by a few cyclads, gill-bearing gastropods, and fresh-water pulmonates. The last, or seventh stage, is the present, which is a land surface with a few small ponds and swampy streamlets.

We have here, then, a succession of geological strata filled with animal and vegetable remains of life which can be correctly interpreted only by one having an extensive and varied acquaintance with the same animals as they are found today. With such knowledge a perfect picture of the ecology of this ancient bay can be drawn, the plant and animal communities in the different strata reflecting accurately the varying physical conditions as the water became shallower or deeper. Without the aid of ecology the beds of shells and other remains are utterly without meaning. Such deposits have been noted by geologists and dismissed with the simple statement that "molluscan shells were present," information that tells nothing and leaves one in doubt as to just what conditions prevailed at the time the deposits were formed.

A recent study of the literature relating to glacial deposits, as well as the examination of glacial material containing the remains of life, indicate that many errors have been made by geologists because due attention was not paid to the ecology of the species contained in the deposits examined. Many years ago, Worthen, the State geologist of Illinois,[2] reported land and fresh-water shells from a loess deposit near Alton, Illinois. Recently, material from this locality has been examined and found to contain an abundance of land shells, but no fresh-water shells. The presence of a *Succinea* probably indicates the source of the report of fresh-water shells. The genus *Succinea* embraces at least two ecological groups which are quite distinct as regards their habitats; one, represented by *Succinea retusa,* is usually found in the vicinity of water, especially the borders of ponds and lakes, where it occurs on emergent vegetation, on the wet margins of the shores, and sometimes actually in the water, where it may have fallen or been forced from some adjacent vegetation; the other group, represented by *Succinea ovalis,* lives in upland regions away from water, and usually in forests of some size. The species at Alton is of the latter or upland type and the associated species, *Polygyra profunda* and *Polygyra multilineata,* are all land mollusks. The deposit is true loess, a fact indicated by the presence of typical land mollusks and the absence of fresh-water species.

The interpretation of loess deposits is frequently attended with difficulty if the ecology of the species contained in the deposit is not known and taken into account. A collection recently received for determination contained both land and fresh-water species of mollusks, the latter predominating. One not well acquainted with the species and taking simply the fact that they were inhabitants of fresh water (and the loess is said not to contain species of this character) would feel justified in referring the deposit to the action of water. A study of the ecology of the species, however, tells quite another story. Two fresh-water species of mollusks were represented by many specimens. These were *Pomatiopsis lapidaria* and *Galba obrussa.* The first is not an inhabitant of lakes or ponds, but of small streams, almost rivulets, a foot or two wide, which usually flow through open forests. The *Galba* inhabits similar situations. The land shell present in this deposit, *Helicodiscus parallelus,* is commonly found in woodlands near such small streams (also found where there are no streams), under started bark, pieces of bark, and other debris.

When analyzed from the ecological standpoint the species are seen to be in perfect harmony with aeolian deposits. The locality from which the material came was once forest covered, and a small stream flowed through it inhabited by these small snails. Later, the stream may have become dry, as frequently happens in the autumn, and loess deposits formed, covering up the stream bed and burying the mollusks. With a knowledge of the ecology of the species it is comparatively easy to reconstruct the fauna and build up a picture of the environment.

Much of the old controversy as to where the loess was water or wind laid was based on the presence of these water snails, and even clams, for *Sphaerium occidentale* is common in woodland pools that dry up in summer and may become filled with wind-blown sand and fine particles of soil. Little attention was given by most glacialogists to the precise ecology of the species found in these deposits, which were usually identified by other people and the name used by the geologists working on the species. If the specialists naming the species indicated that they were of fresh-water origin this was sufficient for the worker who built up his theories on this data. The subject of loess fossils and their interpretation as regards the deposits in which they occurred has been ably discussed by Professor B. Shimek, who has given this subject long attention.[3]

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[2] Geol. Ill., I, p. 315.

The above examples are sufficient for my purpose, which is to emphasize the value and importance of ecological studies in the consideration of fossil deposits and their faunas. This is especially true of the deposits laid down during the last geological period, the Pleistocene, and to correctly interpret many of these deposits one must have a wide knowledge of the ecology of the animal life of the temperate and boreal parts of America. The presence of fresh-water shells does not necessarily mean that a lake or river was present when certain deposits were formed. It depends entirely upon just what species are present. As has been stated, such mollusks as *Pomatiopsis, Galba obrussa, Physa gyrina,* or *Sphaerium occidentale* indicate that a small swale or woodland pool was present; or perhaps a small rivulet or stream in the forest; river mussels, *Campeloma,* and *Goniobasis* or *Pleurocera* would usually indicate a large stream like a river. Sometimes there will be a mixture of both land and fresh-water species, including woodland types of land shells and river types of water shells, and here the deposit would be interpreted as a flood plain of a river in which the land shells (mostly dead and without the animal) had been washed down and mingled with the water shells, which had also been washed down the river by high water or floods.

There is no more fascinating branch of science than the interpretation of the fossil faunas which lived before, during, and after the ice age, and when the knowledge of modern ecology is applied to the species it becomes comparatively easy to reconstruct the biota and to make conclusions as we would from the study of living animals and plants in a modern habitat. The study of fossil faunas is, then, largely dependent upon ecology for their correct interpretation.

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[3] Science, N. S., XXXVII, pp. 501–509, 1913.